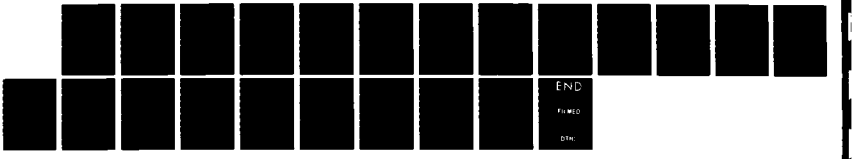
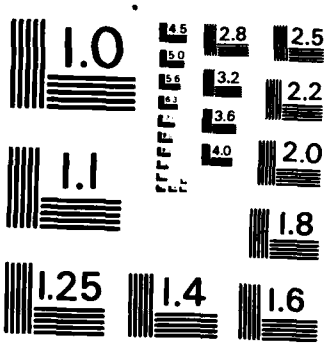
AD-A161 250 MEASUREMENT OF ATMOSPHERIC TRANSMISSION OVER LONG PATHS IN THE INFRARED S..(U) TECHNION - ISRAEL INST OF TECH HAIFA DEPT OF PHYSICS U P OPPENHEIM ET AL. 15 APR 85 1/1

UNCLASSIFIED AFOSR-TR-85-0890 AFOSR-83-0023 F/G 20/6 NL





Grant AFOSR-83-0023

Final Scientific Report

MEASUREMENT OF ATMOSPHERIC TRANSMISSION OVER LONG PATHS IN THE INFRARED SPECTRAL REGION

by

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15 April, 1985.

Final Scientific Report, 1 Jan. 1984 -31 March, 1985.

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Prepared for European Office of Aerospace Research and Development, London, England.

FIELD EXPERIMENTS

Although several field experiments were planned for the period 1 Jan. 1984 - 31 Mar. 1985 only one trip was successful. This trip fulfilled our hope of obtaining high values of absolute humidity, and water vapor amount. It was carried out in the coastal plain of Israel, near the settlement of Palmachim, about 20 km south of Tel Aviv. The experiment was carried out during September 20 and 21, 1984.

Another experiment was attempted on the Golan Heights in the winter of 1984/85 (on March 31, 1985) but had to be abandoned because of prevailing fog and rain.

The Palmachim experiment was carried out over a north-south optical path of 8.6 km length, along the shore of the mediterranian. The black-body source was kept at 2100°C and the dual-channel spectroradiometer was used to measure the spectrum, using circular variable filters with 4% resolution. Full details of the experiment were described in our previous Interim Scientific Report dated February 29, 1984 (Grant AFOSR-83-0023).

The optical path ran parallel to the seashore at a distance of about 100 meters. The altitude was 40 meters. The latitude of the site was 30° 55'. The experiment was carried out as a series of "runs", numbered consecutively PAL 1, PAL 2, ... PAL 34. Not all runs were included with this report, because many were devoted to calibrations and were therefore not relevant. PAL 9 to PAL 20 were made after nightfall of September 20, 1984, between 6 and 11 p.m. The rest of the runs from PAL 21 to PAL 34

were taken between 6 and 11 a.m. on September 21, 1984 (after sunrise).

The transmittance was designated T(L2) and plotted as a function of wavelength in the attached figures. Each figure has a legend of 7 lines with the following entries:

Name of entry	Explanation of entry
Name of experiment	Running number (PAL 1, etc.); detector InSb or CMT (cadmium mercury telluride); date.
Temperature	Temperature in degrees C.
Distance	Optical path in km.
Relative humidity	Relative humidity in percent.
H20 pressure	Partial pressure of water vapor in torr.
Visibility	Visual range (human observer)
Pressure	Total atmospheric pressure in millibar.

Each figure contains two curves: the full curve represents the experimental transmittance, while the dotted curve represents the calculated transmittance according to LOWTRAN 4, with a resolution of 5 cm^{-1}, convoluted with a triangular slit function of 25 cm^{-1}.

The LOWTRAN calculation was carried out assuming a midlatitude summer model. It should be noted that the full curve looks "broken" because of the finite resolution of the graphics. There are 16 figures in the 3 to 5 micron range, and 17 figures in the 8 to 13 micron range.*

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* Digital results are available in table format for all figures.

The maximum amount of water vapor in the path was approximately 17 g/cm^2.

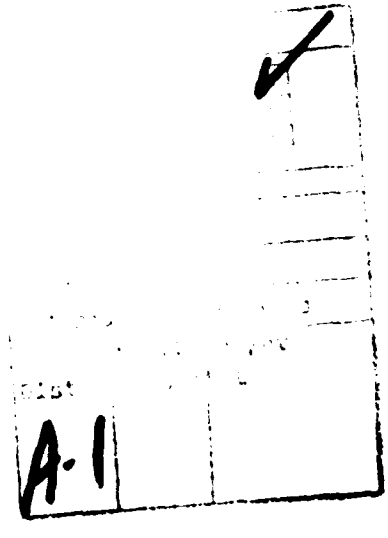
A systematic study of these curves is now under way.

PUBLICATIONS

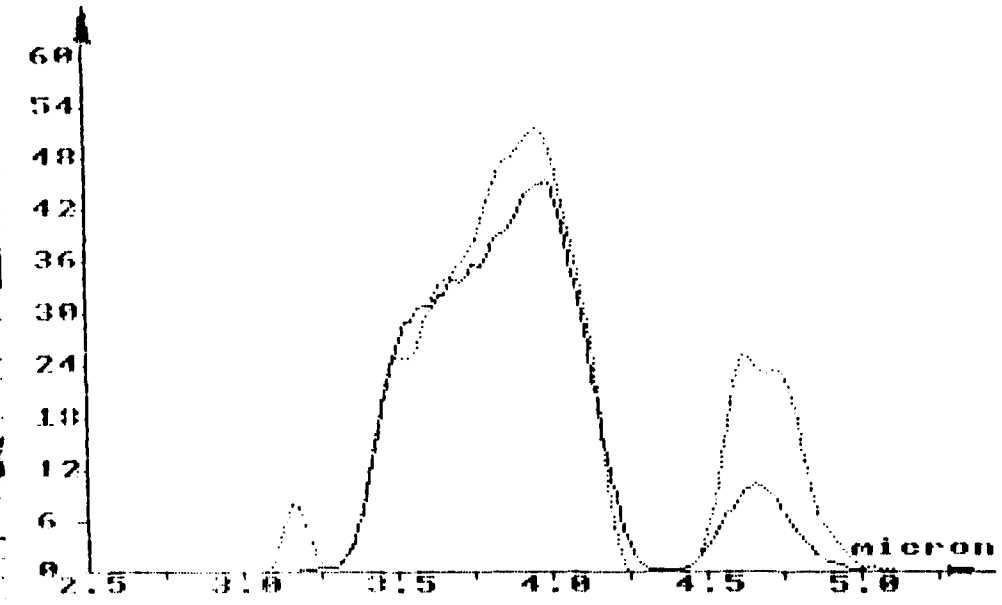
During the period under consideration two papers were read at international meetings:

1. A. Ben-Shalom, A.D. Devir, S.G. Lipson, U.P. Oppenheim and E. Ribak, "Absorption of IR radiation by atmospheric water vapor in the regions 4.3-5.5 micron and 8-13 micron", Third International Conference on IR physics, Zurich (1984).

2. A. Ben-Shalom, A.D. Devir, S.G. Lipson, U.P. Oppenheim and E. Ribak, "Absorption of IR radiation by atmospheric water vapor in the regions 4.3-5.5 micron and 8-13 micron", Topical Meeting on optical remote sensing of the atmosphere, Incline Village, Nevada (1985).

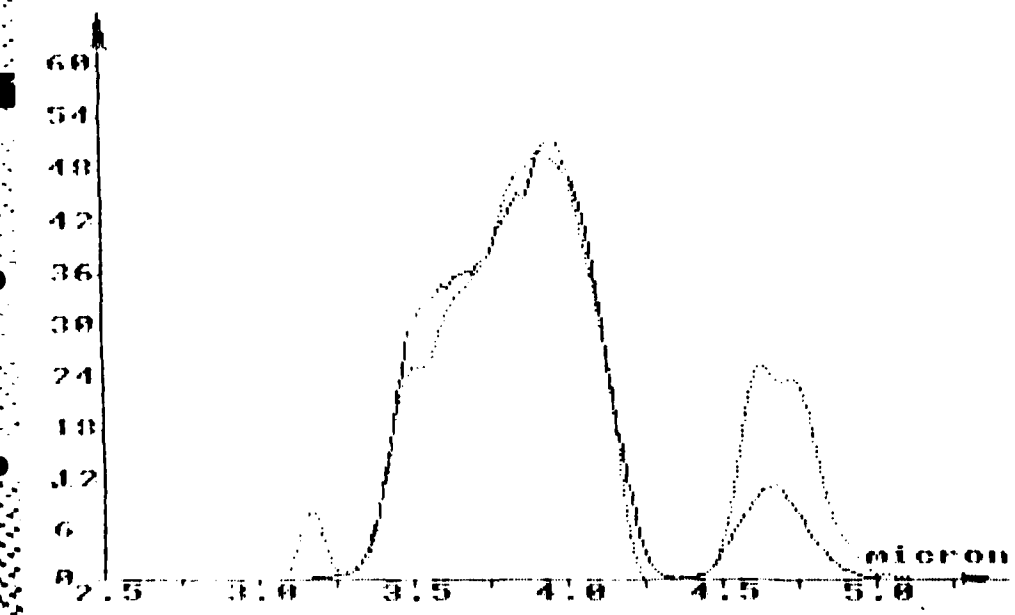


TRANSMITTANCE



NAME OF EXPERIMENT		PAL10 INSB	20/9/84
TEMPERATURE	26.4 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	76%		
H2O PRESSURE	19.7 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		

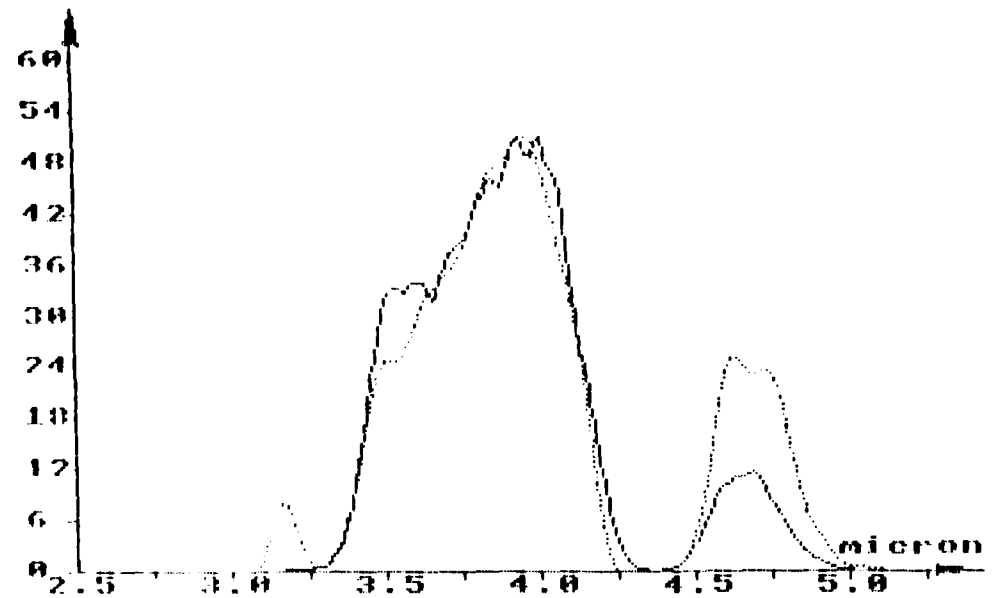
TRANSMITTANCE



NAME OF EXPERIMENT		PAL12 INSB	20/9/84
TEMPERATURE	24.9 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	81%		
H2O PRESSURE	19.2 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		

TRANSMITTANCE

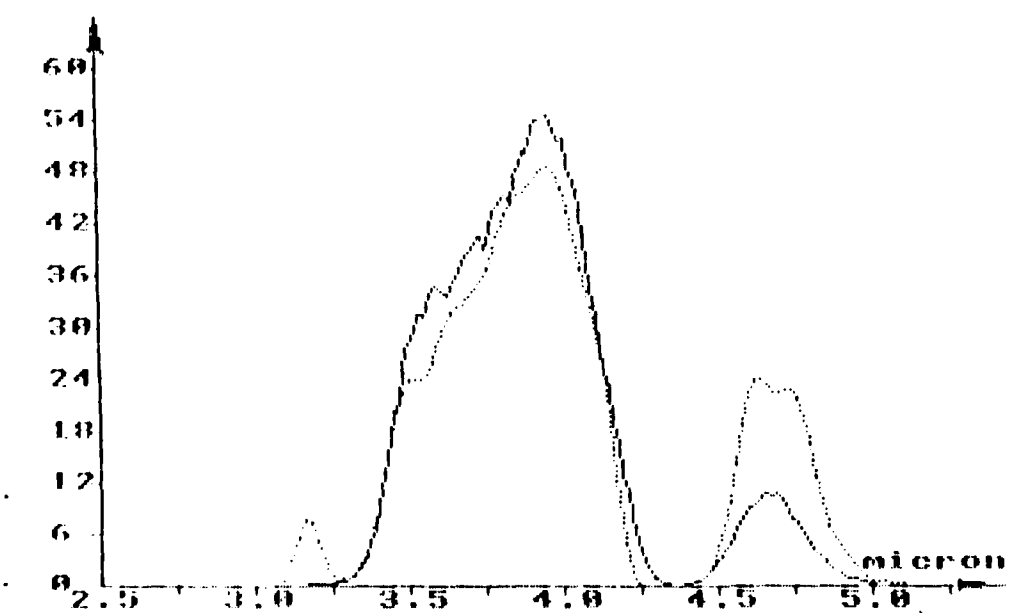
T(L2) %



NAME OF EXPERIMENT		PAL13 INSB	20/9/84
TEMPERATURE	24.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	85%		
H2O PRESSURE	19.6 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		

TRANSMITTANCE

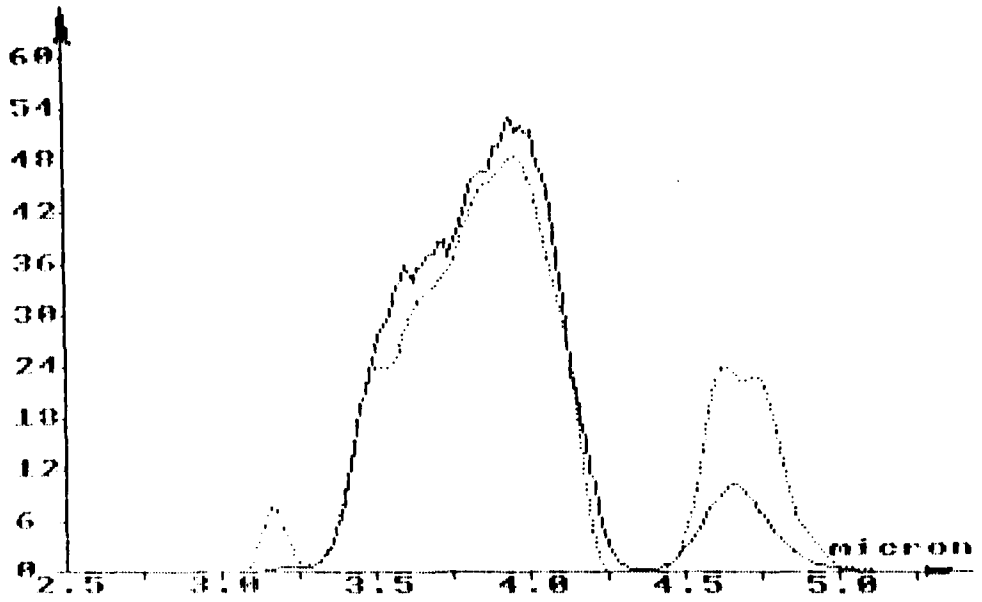
T(L2) %



NAME OF EXPERIMENT		PAL14 INSB	20/9/84
TEMPERATURE	22.9 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	88%		
H2O PRESSURE	18.5 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		

TRANSMITTANCE

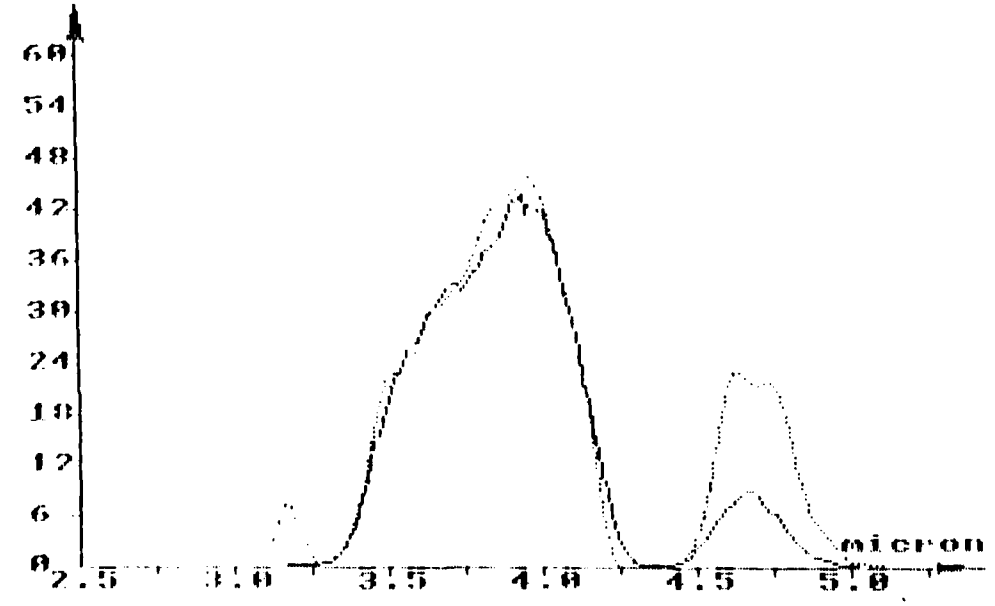
I(L2) %



NAME OF EXPERIMENT		PAL15 INSB	20/9/84
TEMPERATURE	22.9 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	88%		
H2O PRESSURE	18.5 mmHG		
VISIBILITY	12 km		
PRESSURE	1009 mb		

TRANSMITTANCE

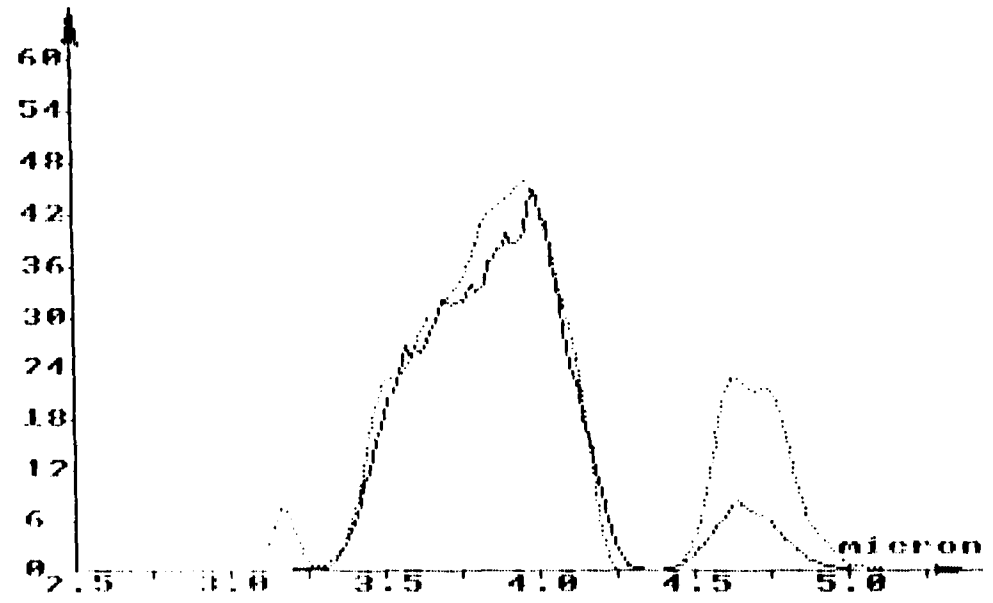
I(L2) %



NAME OF EXPERIMENT		PAL19 INSB	20/9/84
TEMPERATURE	21.3 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	95%		
H2O PRESSURE	18.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

TRANSMITTANCE

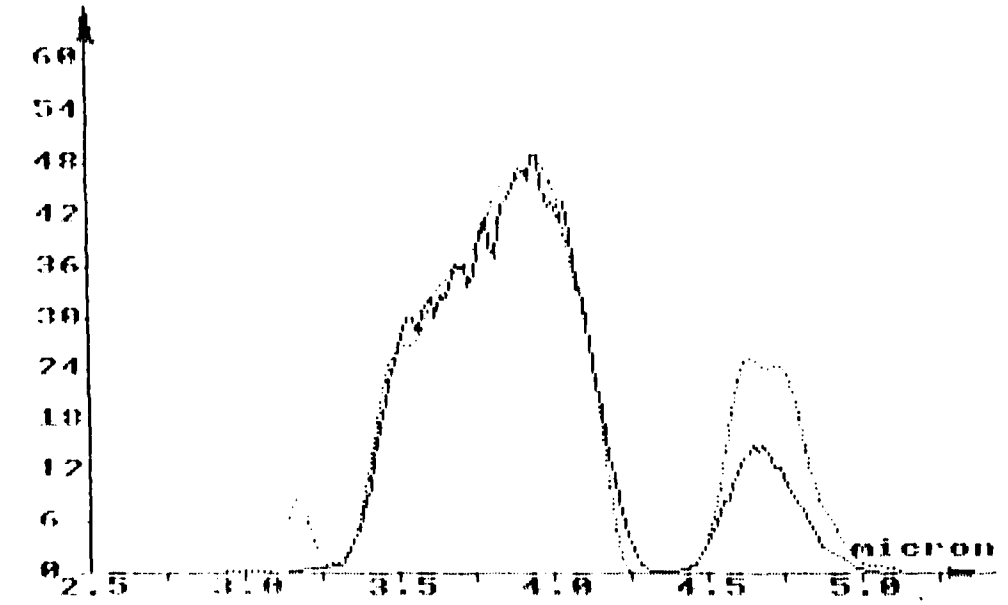
I(L2) %



NAME OF EXPERIMENT		PAL20 INSB	20/9/84
TEMPERATURE	21.3 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	95%		
H20 PRESSURE	18.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

TRANSMITTANCE

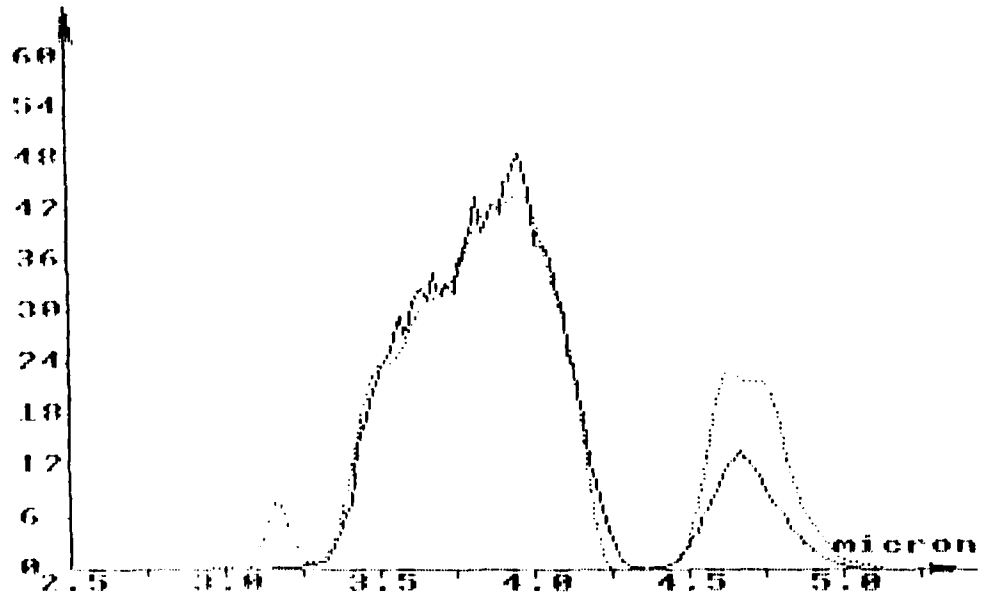
I(L2) %



NAME OF EXPERIMENT		PAL22 INSB	20/9/84
TEMPERATURE	19.1 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	86%		
H20 PRESSURE	14.3 mmHG		
VISIBILITY	10 km		
PRESSURE	1006 mb		

TRANSMITTANCE

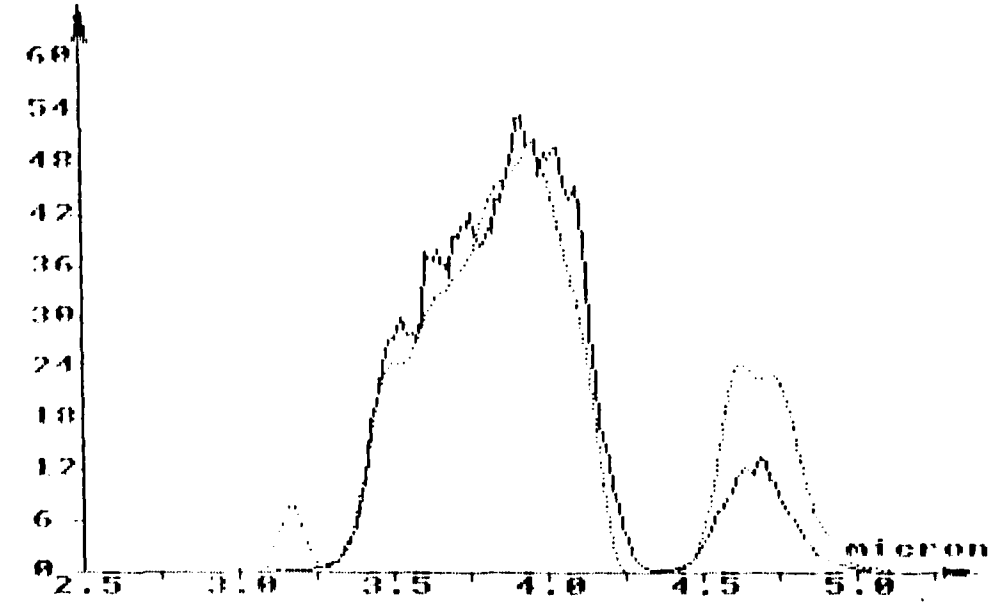
I(L2) %



NAME OF EXPERIMENT		PAL23 INSB	20/9/84
TEMPERATURE	20.5 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	82%		
H2O PRESSURE	14.9 mmHG		
VISIBILITY	8 km		
PRESSURE	1006 mb		

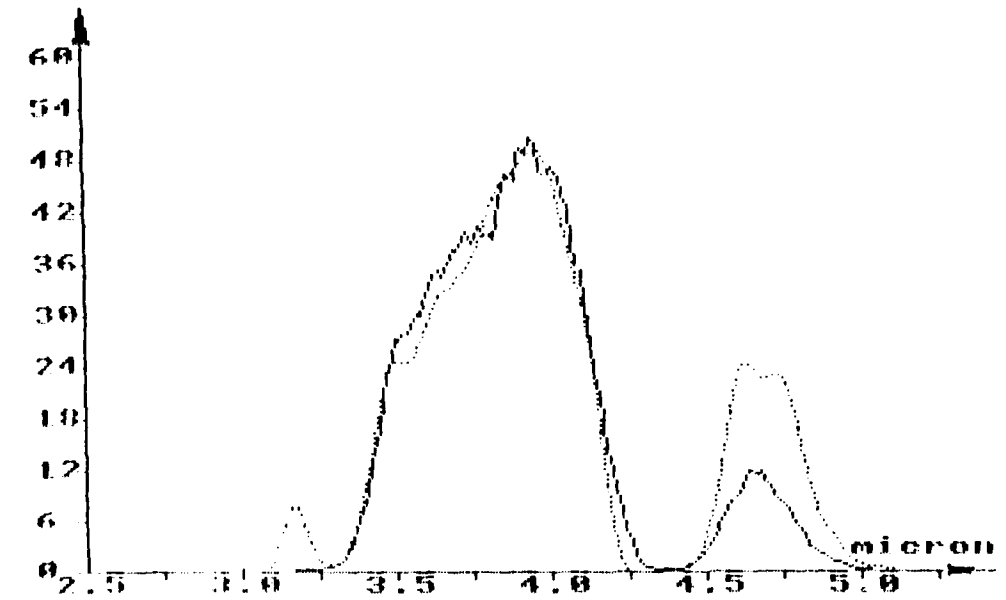
TRANSMITTANCE

I(L2) %



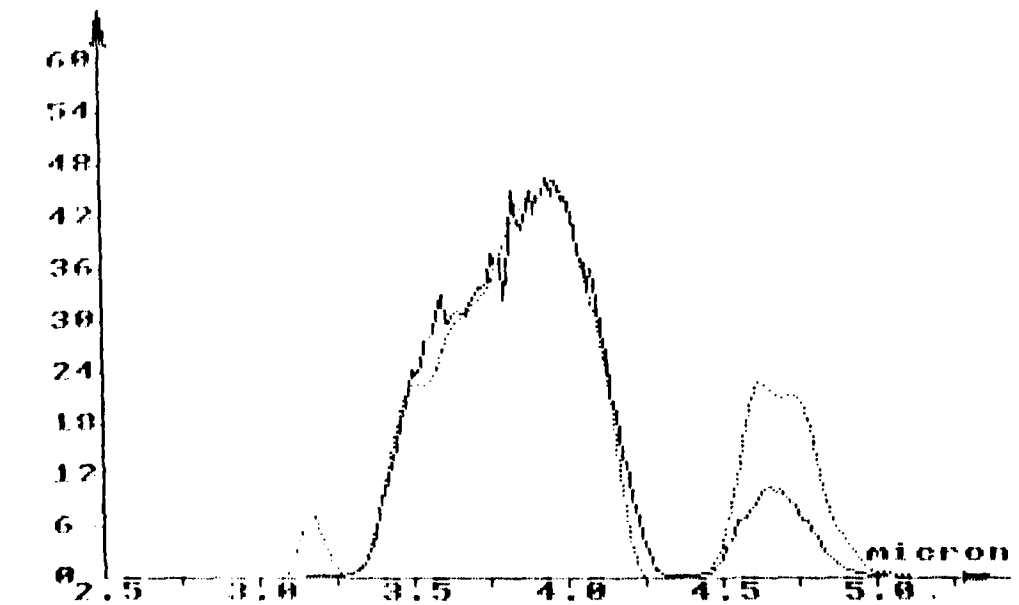
NAME OF EXPERIMENT		PAL27 INSB	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	75%		
H2O PRESSURE	18.4 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		

TRANSMITTANCE



NAME OF EXPERIMENT		PAL28 INSB	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	75%		
H2O PRESSURE	18.4 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		

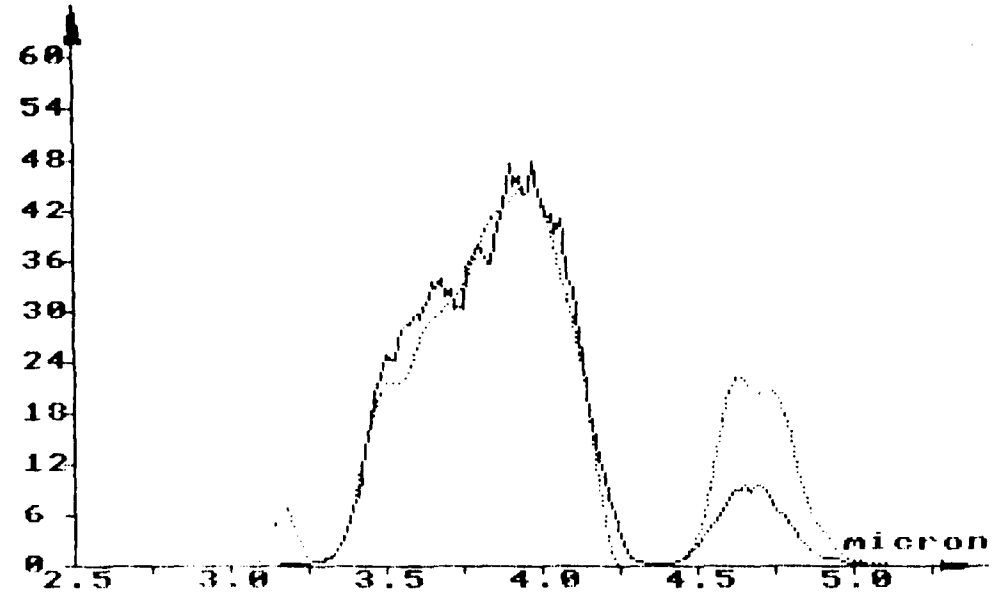
TRANSMITTANCE



NAME OF EXPERIMENT		PAL29 INSB	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	77.5%		
H2O PRESSURE	19 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

T(L2) %

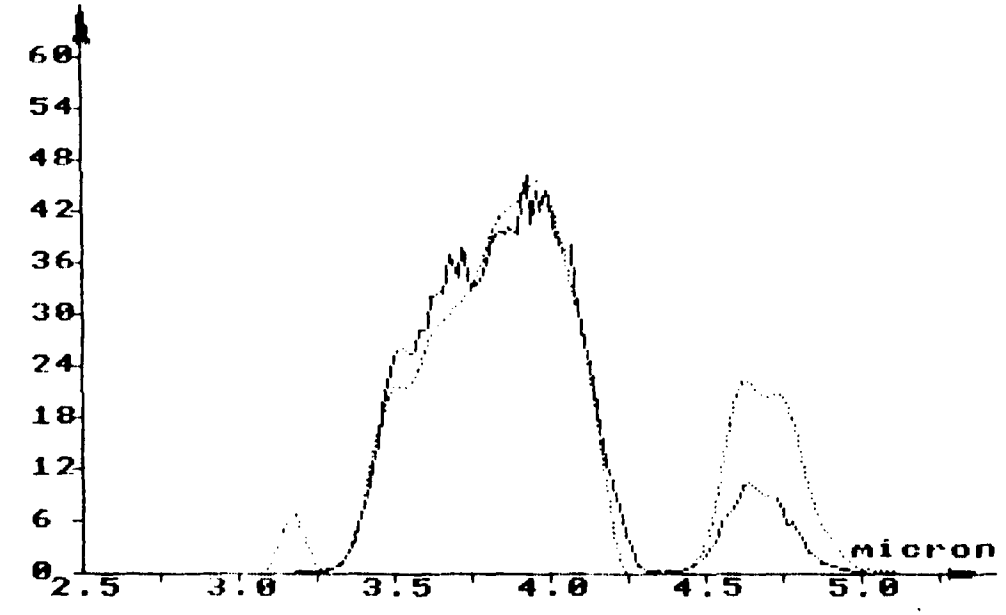
TRANSMITTANCE



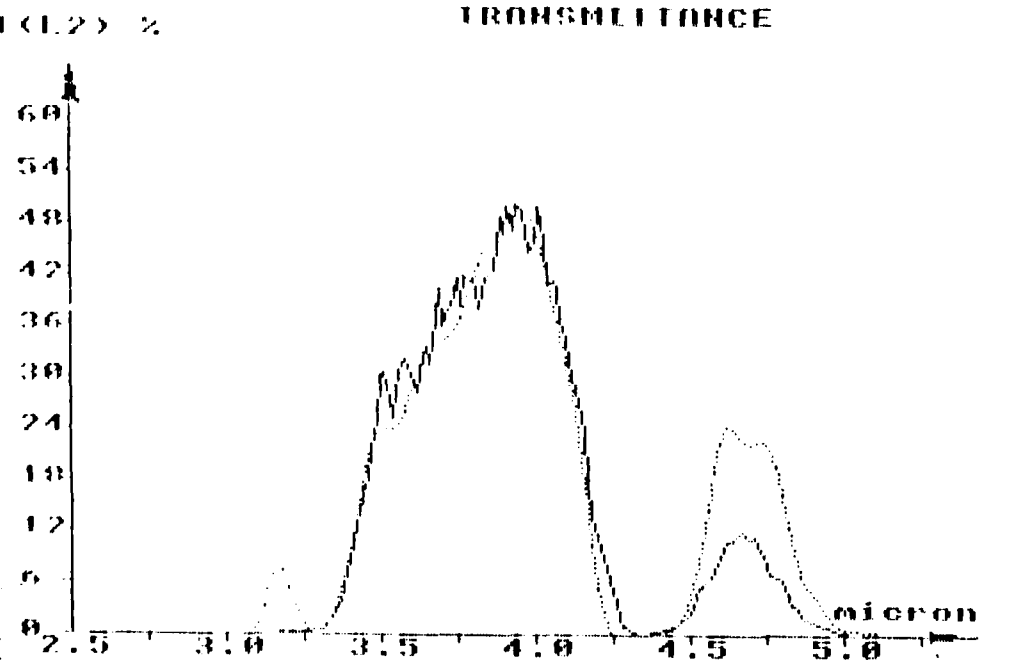
NAME OF EXPERIMENT		PAL30 INSB	20/9/84
TEMPERATURE	26.1 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	79%		
H2O PRESSURE	20.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

T(L2) %

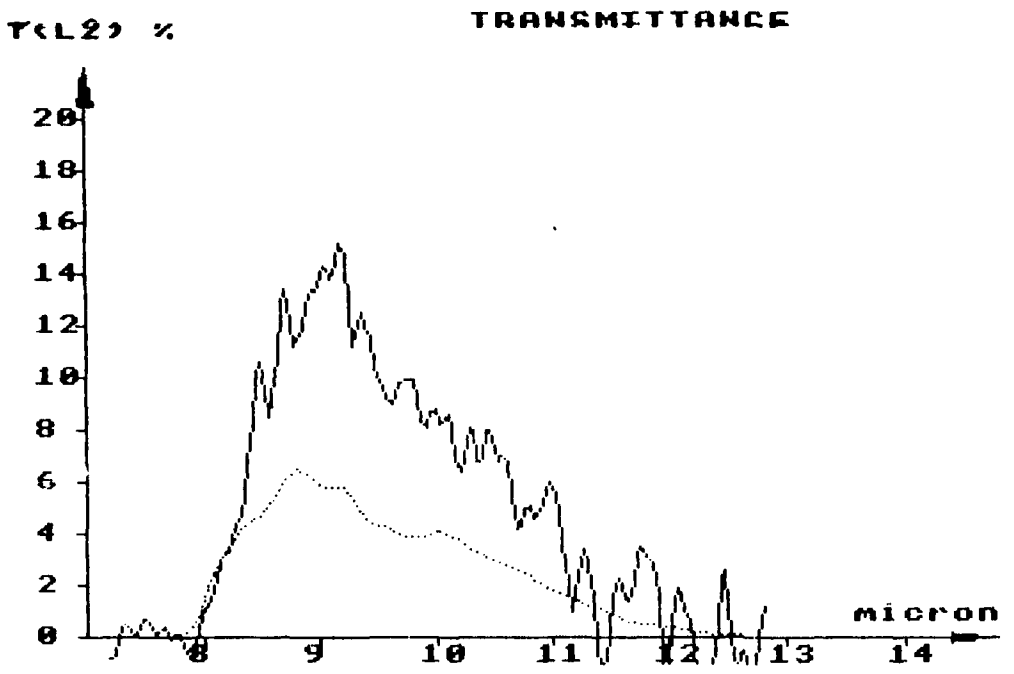
TRANSMITTANCE



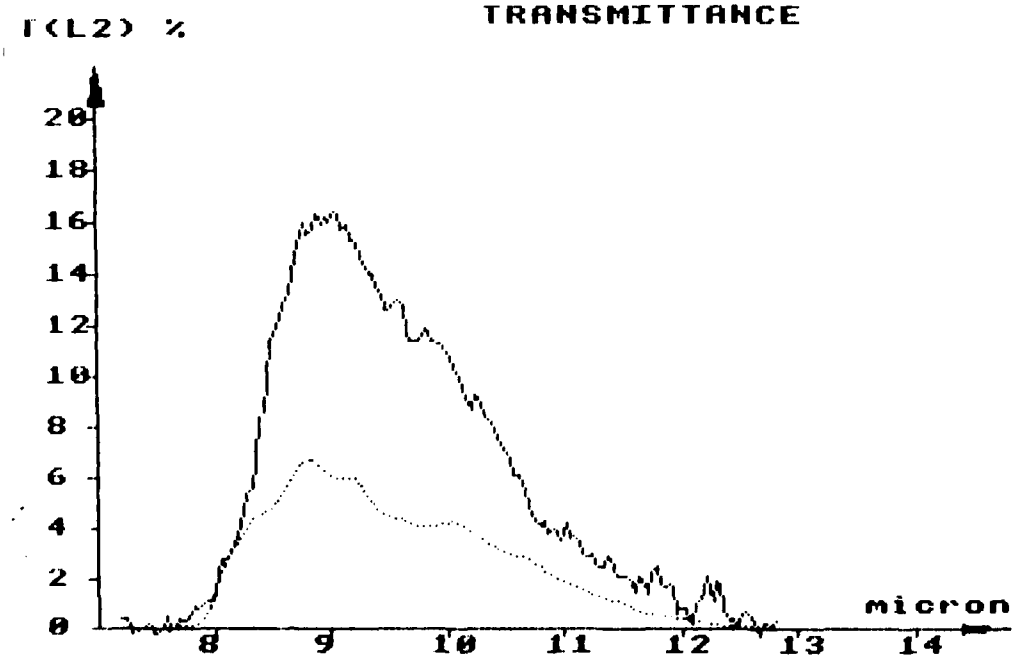
NAME OF EXPERIMENT		PAL31 INSB	20/9/84
TEMPERATURE	26.1 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	79%		
H2O PRESSURE	20.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		



NAME OF EXPERIMENT	PAL34 INSB	20/9/84
TEMPERATURE	27.4 C	
DISTANCE	8.6 km	
RELATIVE UMIDITY	73%	
H2O PRESSURE	20 mmHG	
VISIBILITY	13 km	
PRESSURE	1006 mb	

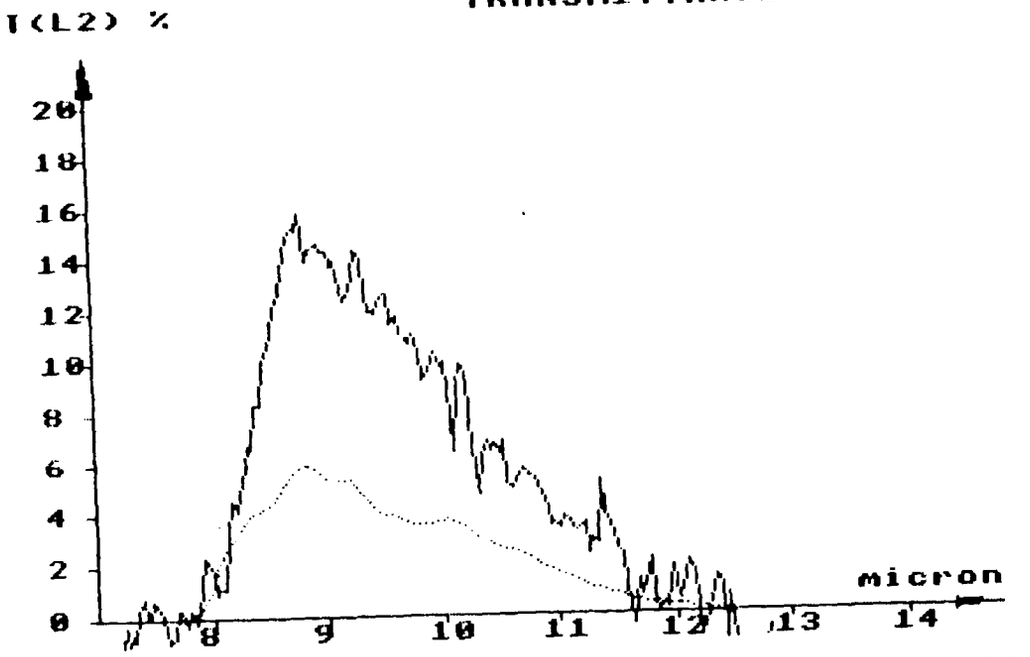


NAME OF EXPERIMENT	PAL09	CMT	20/9/84
TEMPERATURE	26.4 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	76%		
H2O PRESSURE	19.7 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		



NAME OF EXPERIMENT	PAL12	CMT	20/9/84
TEMPERATURE	24.9 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	81%		
H2O PRESSURE	19.2 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		

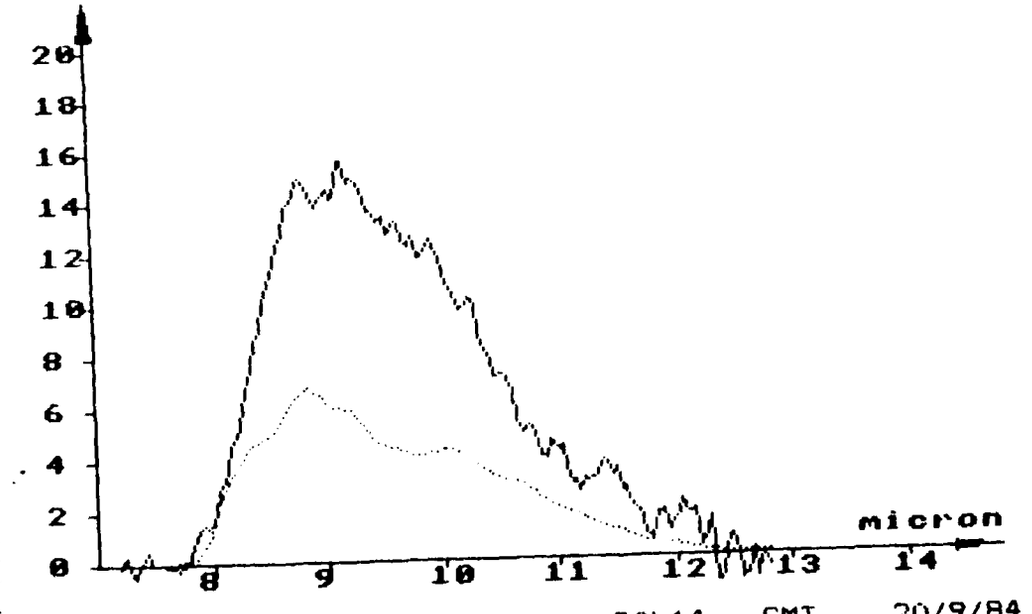
TRANSMITTANCE



PAL13 CMT 20/9/84

NAME OF EXPERIMENT	
TEMPERATURE	24.5 C
DISTANCE	8.6 km
RELATIVE UMIDITY	85%
H2O PRESSURE	19.6 mmHG
VISIBILITY	15 km
PRESSURE	1008 mb

TRANSMITTANCE

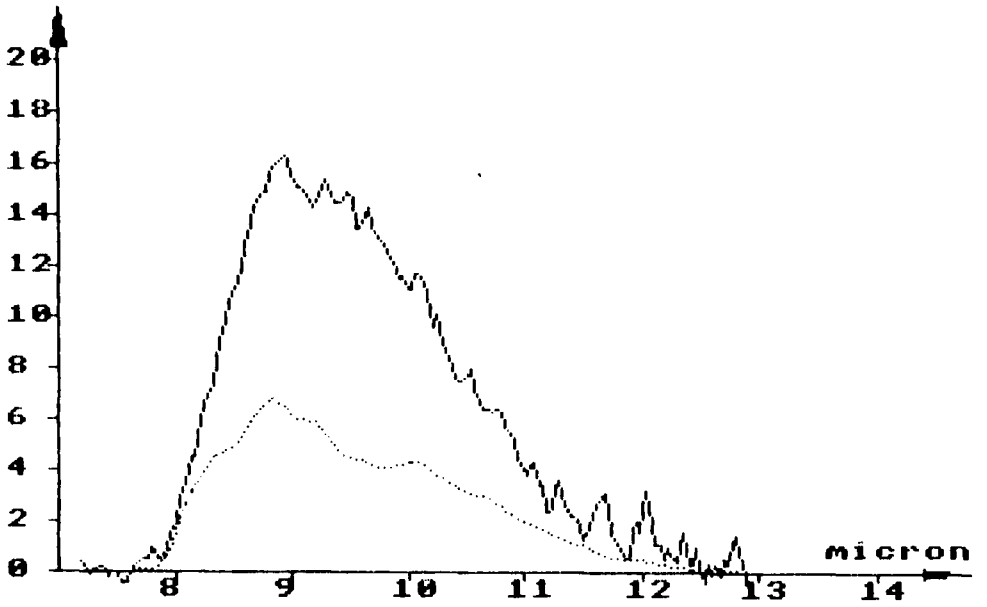


PAL14 CMT 20/9/84

NAME OF EXPERIMENT	
TEMPERATURE	22.9 C
DISTANCE	8.6 km
RELATIVE UMIDITY	88%
H2O PRESSURE	18.5 mmHG
VISIBILITY	12 km
PRESSURE	1009 mb

T(L2) %

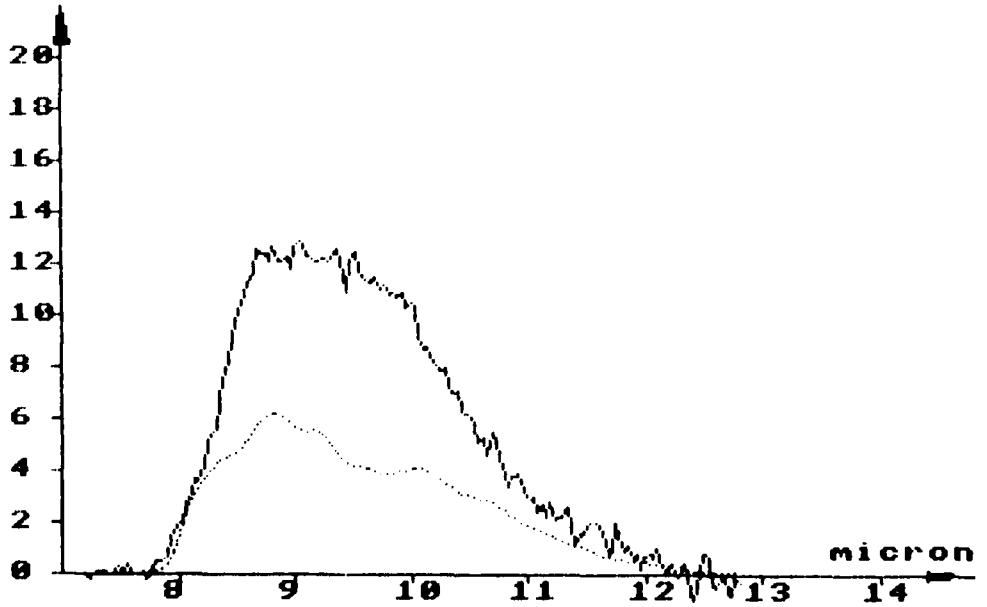
TRANSMITTANCE



NAME OF EXPERIMENT		PAL15 CMT	20/9/84
TEMPERATURE	22.9 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	88%		
H20 PRESSURE	18.5 mmHG		
VISIBILITY	12 km		
PRESSURE	1009 mb		

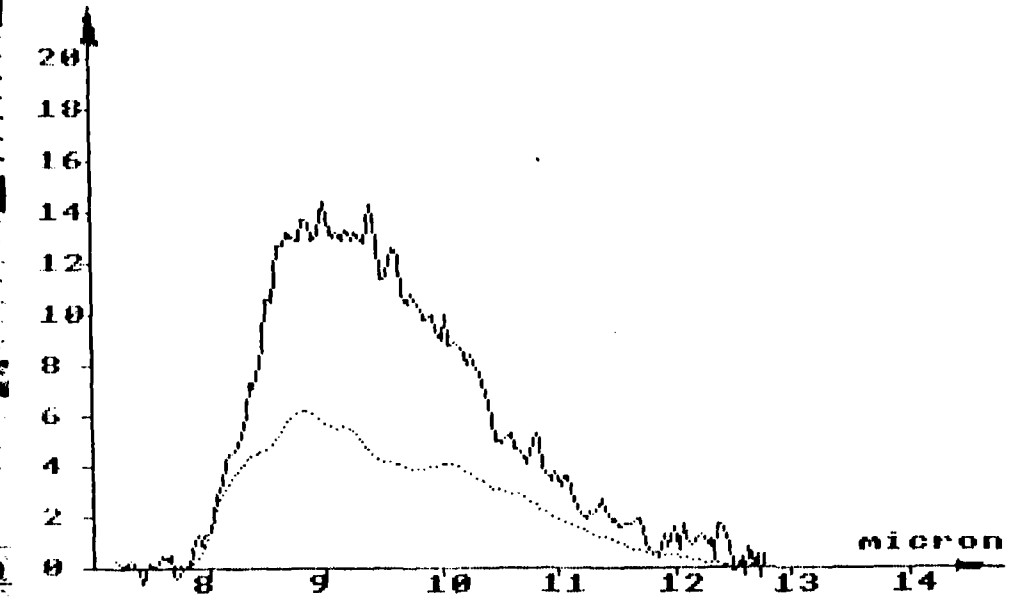
T(L2) %

TRANSMITTANCE



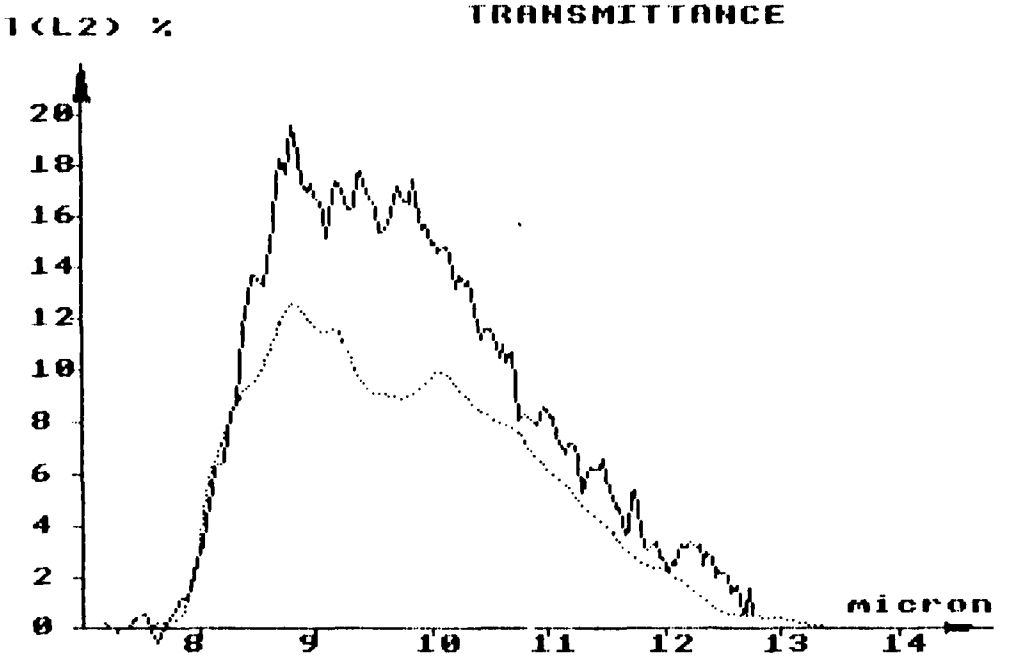
NAME OF EXPERIMENT		PAL19 CMT	20/9/84
TEMPERATURE	21.3 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	94.5%		
H20 PRESSURE	18.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

TRANSMITTANCE



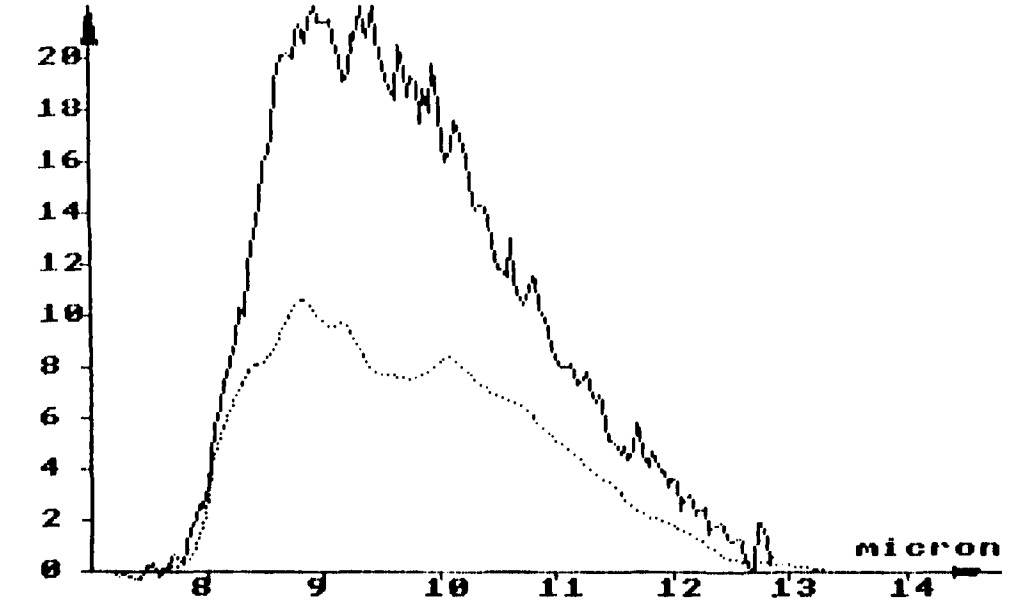
NAME OF EXPERIMENT		PAL20 CMT	20/9/84
TEMPERATURE	21.3 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	95%		
H2O PRESSURE	18.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

TRANSMITTANCE

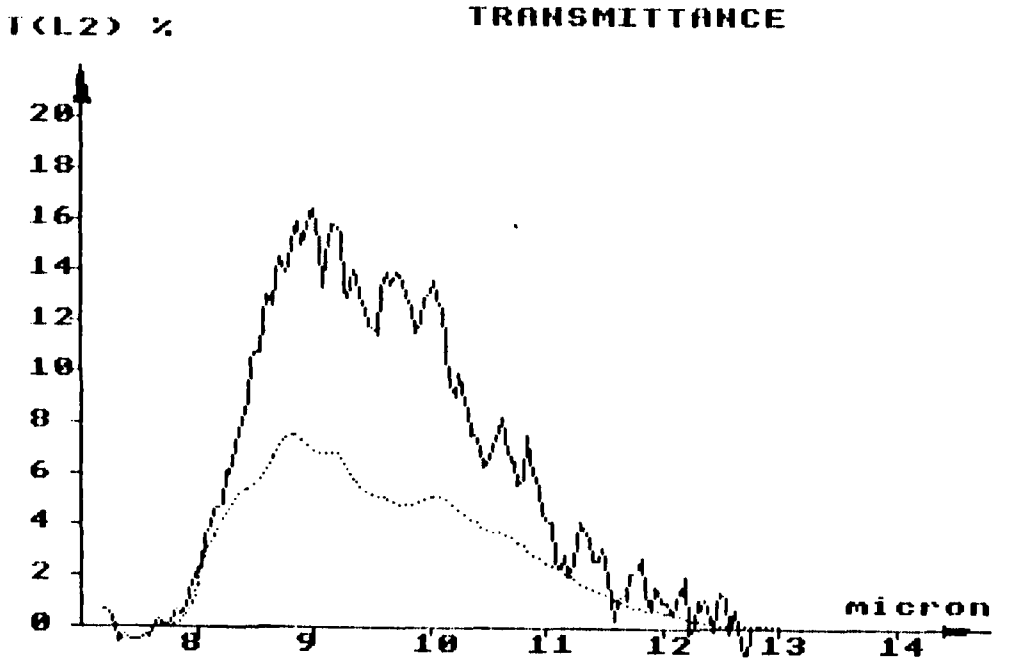


NAME OF EXPERIMENT		PAL22 CMT	20/9/84
TEMPERATURE	19.1 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	86%		
H2O PRESSURE	14.3 mmHG		
VISIBILITY	10 km		
PRESSURE	1006 mb		

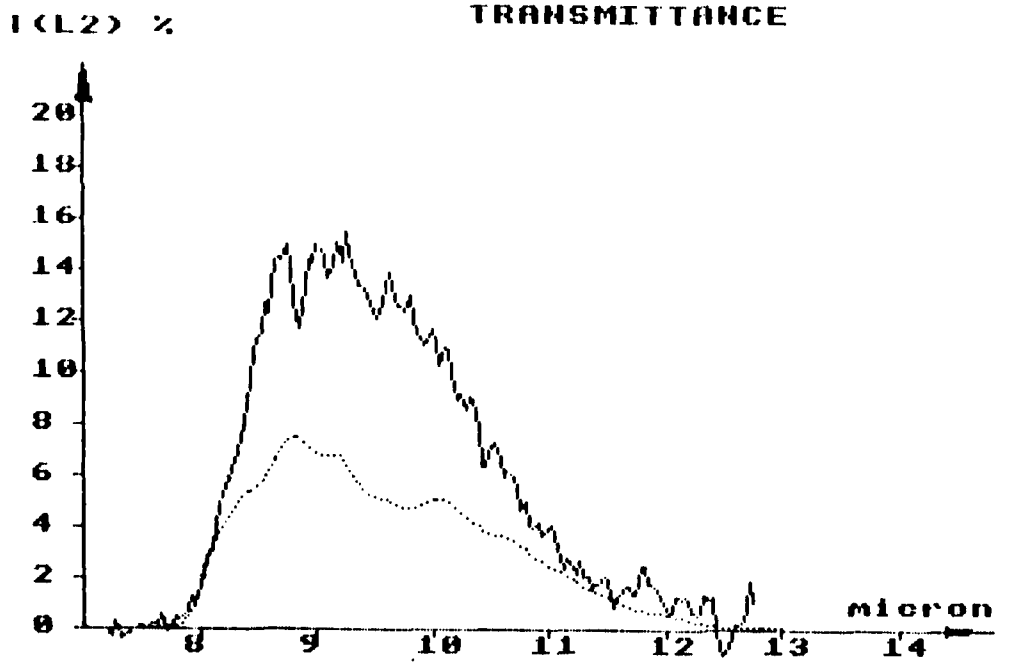
TRANSMITTANCE



NAME OF EXPERIMENT		PAL23 CMT	20/9/84
TEMPERATURE	20.5 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	82%		
H2O PRESSURE	14.9 mmHG		
VISIBILITY	8 km		
PRESSURE	1006 mb		

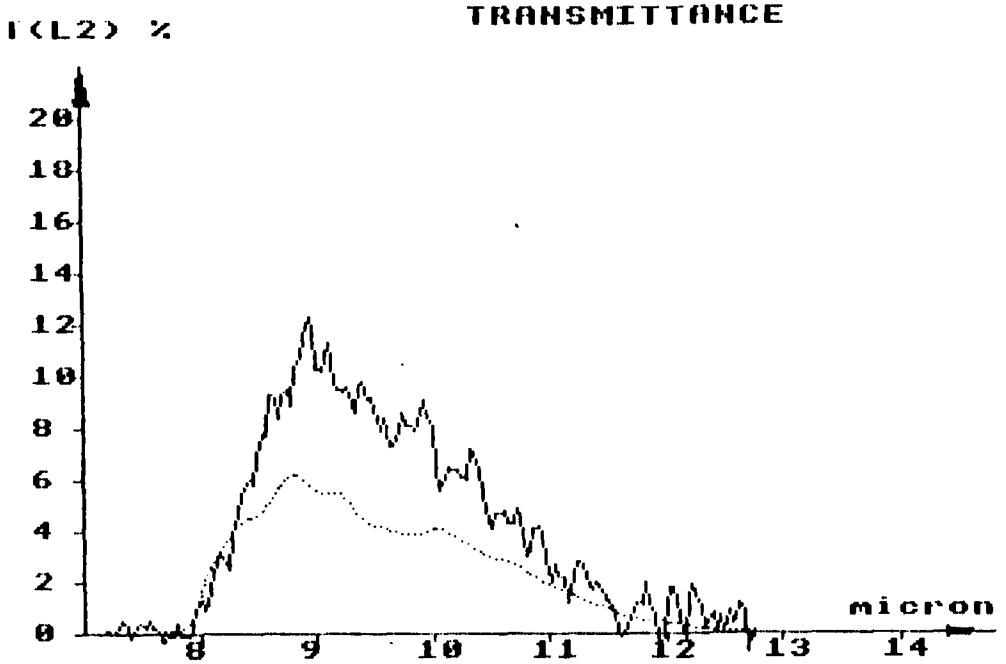


NAME OF EXPERIMENT		PAL27 CMT	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	75%		
H2O PRESSURE	18.4 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		



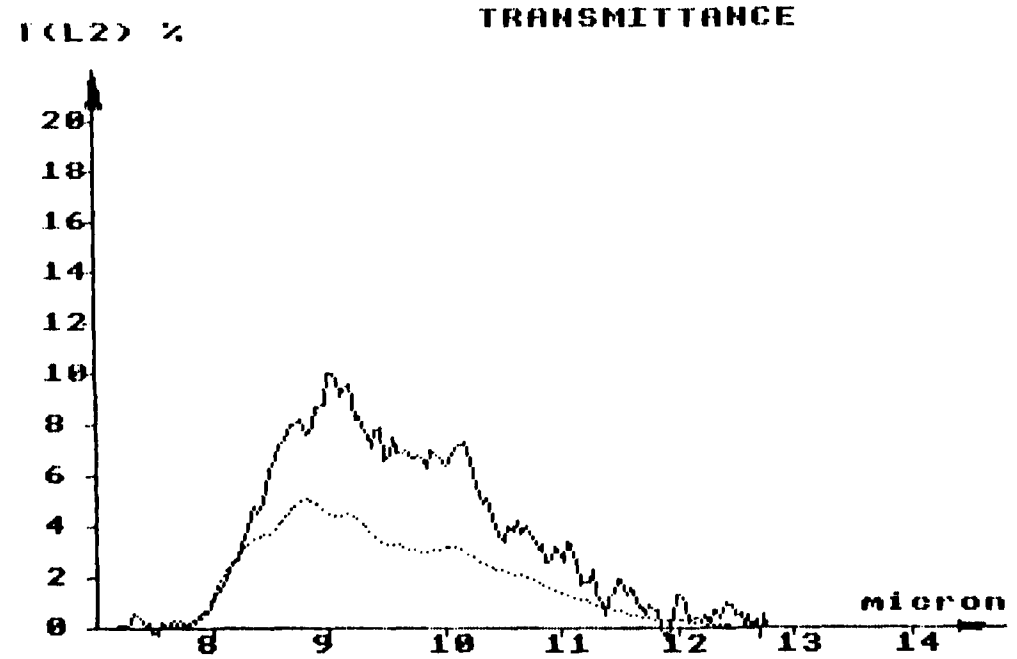
NAME OF EXPERIMENT		PAL28 CMT	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	75%		
H2O PRESSURE	18.4 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		

TRANSMITTANCE



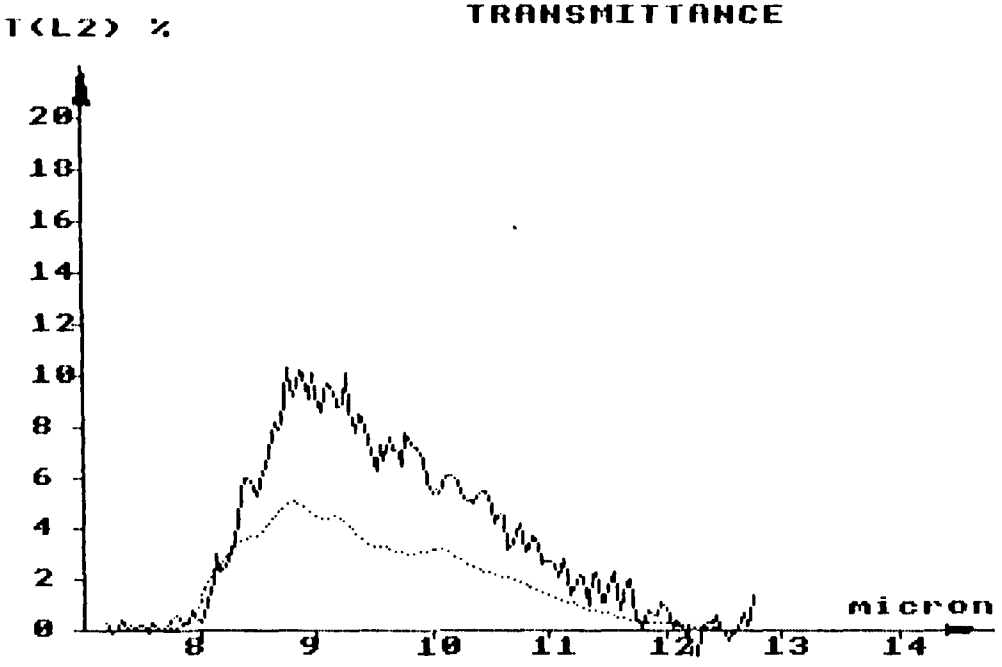
NAME OF EXPERIMENT		PAL29 CMT	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	77.5%		
H2O PRESSURE	19 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

TRANSMITTANCE



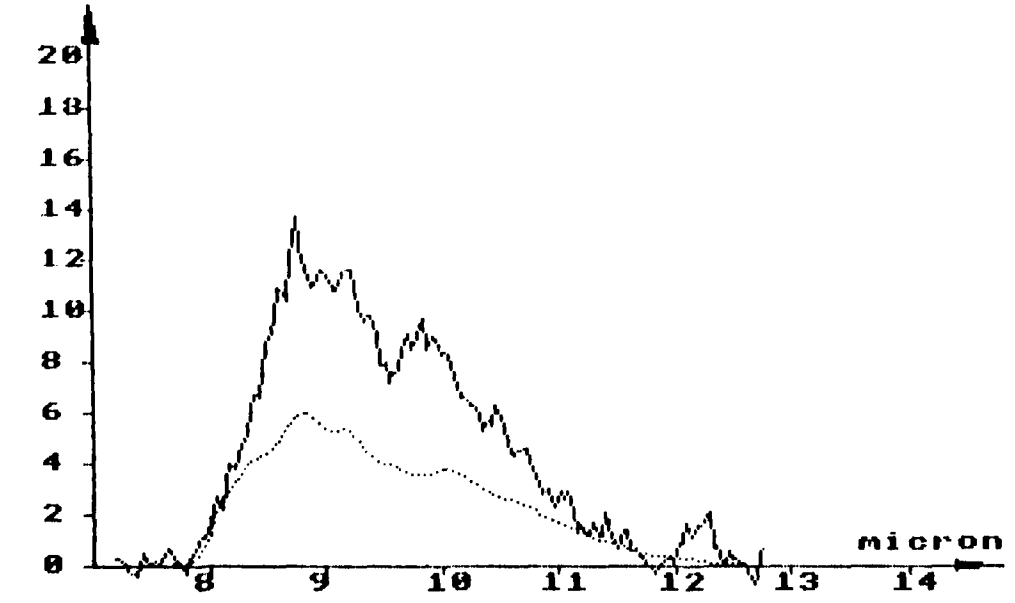
NAME OF EXPERIMENT		PAL30 CMT	20/9/84
TEMPERATURE	26.1 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	79%		
H2O PRESSURE	20.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

TRANSMITTANCE



NAME OF EXPERIMENT		PAL31 CMT	20/9/84
TEMPERATURE	26.1 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	79%		
H2O PRESSURE	20.1 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

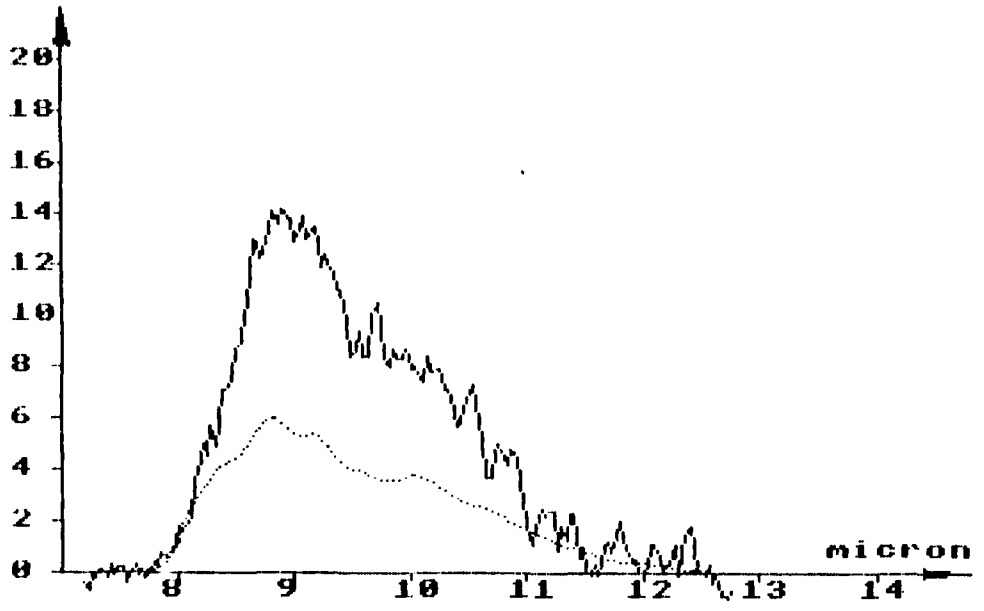
TRANSMITTANCE



NAME OF EXPERIMENT		PAL33 CMT	20/9/84
TEMPERATURE	27.4 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	73%		
H2O PRESSURE	20 mmHG		
VISIBILITY	13 km		
PRESSURE	1006 mb		

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT		PAL34 CMT	20/9/84
TEMPERATURE	27.4 C		
DISTANCE	8.6 km		
RELATIVE UMIDITY	73%		
H2O PRESSURE	20 mmHG		
VISIBILITY	13 km		
PRESSURE	1006 mb		

END

FILMED

12-85

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